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FACTS CONCERNING THE HISTORY, COMMERCE,
AND MANUFACTURE OF BUTTER.

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THE USES OF BUTTER IN ANCIENT TIMES.

Butter is one of the oldest of all the articles of present diet. We learn from the Vedas, written 2000 to 1400 B. C., that the Hindoos were interested in cattle raising, that they valued their cows according to their yield of butter, and that they used butter as food. The quality of the article as then made is very uncertain. From the Greek derivation of the word, which means cow cheese, it may be inferred that it contained nearly as much casein as fat, and was, perhaps, hardly entitled to the name of butter, as the article is now known.

From "Kirne and Kerbe," Martiny's work, we gather that a number of foreign countries, which at the present time have little or no dairy interests, were among the first to make some use of butter. Among the peoples who used butter before the Christian era may be mentioned the Scythians, to whom it was known as early as 450 B. C., and the Greeks, who used it about the same time. A little later than this the Persians made butter, and Strabo states that about 60 years B. C. it was used by the Portuguese.

In early times butter was employed in many ways. The Hindoos used it for the greatest and holiest sacrifices in their worship. The Greeks and Romans did not use butter as a food, but as the standard remedy for injuries to the skin. The soot of burned butter was regarded as a specific for sore eyes. The Romans also used it as an ointment to enrich the skin and as a dressing for the hair. In the time of Alexander I certain of the Macedonians anointed themselves with milk oil; and Galen records that in many cold regions people used butter in the bath. Historians speak of butter used as a remedy for wounded elephants, and within a century butter was used in large quantities in Scotland and North England for smearing sheep, also as oil for lamps. Besides being applied externally, it was used internally for various troubles. In Spain as late as the seventeenth century butter was to be found in the medicine shops for external use only. In the middle of the previous century "A medicinal and economic treatment of butter" sets forth in detail the value and use

of butter as a remedy. In rural districts in Germany at the present time fresh, unsalted butter is much used as a cooling salve for burns.

Aside from its use as food, a cosmetic, and medicine, the use or possession of butter was long regarded as indicating wealth, and so served to distinguish the rich from the common people. Evidences of this still exist. In both Chilas and Darel a practice exists of storing up butter in the ground. Butter so stored is left a number of years, and, to insure its not being disturbed, a tree may be planted over it. Under these conditions it turns deep red and is highly prized. The owner's wealth is computed by the quantity of butter he has stored up in this manner.

Butter was enjoyed as a food by comparatively few people in its early history; those who did so use it seldom ate it fresh. The general practice was to melt it before storing away, and instead of being a spread it was employed to enrich cooked foods. Others, even in comparatively recent times, used the rancid stored butter as an appetizer. In Dardistan peasants are said to highly value salted butter grease that has been kept a long time, and that which is over one hundred years of age is greatly prized.

Little is known of the part which butter played as an article of commerce in ancient times. However, an early historian states that in the first centuries butter was shipped from India to ports of the Red Sea. In the twelfth century Scandinavian butter was an article of over-sea commerce. The Germans sent ships to Bergen, in Norway, and exchanged their cargoes of wine for butter and dried fish. It is interesting to note that the Scandinavian king considered this practice injurious to his people, and in 1186 compelled the Germans to withdraw their trade. Toward the end of the thirteenth century, among the enumerated wares of commerce imported from thirty-four countries into Belgium, Norway was the only one which included butter. In the fourteenth century butter formed an article of export from Sweden. It may be fairly inferred that butter-making in north and middle Europe, if not indeed in all Europe, was introduced from Scandinavia.

John Houghton, an Englishman, writing on dairying in 1695, speaks of the Irish as rotting their butter by burying it in bogs. His report was confirmed by the discovery, in 1817 and later, of butter thus buried, packed in firkins. This burying of butter in the peat bogs of Ireland may have been for the purpose of storing against a time of need, or to hide it from invaders, or to ripen it for the purpose of developing flavor in a manner similar to cheese ripening.

PRESENT STATUS OF THE BUTTER INDUSTRY.

The butter produced annually in the United States somewhat exceeds 1,500,000,000 pounds, and requires the milk from about 10,000,000 cows. These cows are kept on something like 4,000,000

farms, and furnish occupation, wholly or in part, for about 7,000,000 people, or nearly 10 per cent of the population. The total value of the annual output of butter is nearly \$300,000,000, which is a little more than 5 per cent of all agricultural products of the United States. Considered as a crop, it is exceeded in valuation only by corn, wheat, hay and forage, and cotton.

Although butter is very generally used by all classes, it is an interesting fact that more than one-half of that produced in the United States is made in seven States and half the remainder in seven other States. The transportation in excellent condition of butter produced in large dairy centers to nonproducing States is made possible by a highly developed refrigerating-car system. By this it can be shipped, even during the hottest weather, without being subjected to high and detrimental temperatures.

The methods of conducting the butter industry have changed materially during the past twenty-five years. The greatest factor concerned in these changes was the introduction of the centrifugal cream separator, which did much in developing the creamery system. Other factors having a greater or less influence upon the development of the butter industry are those which have brought the principles of physics, chemistry, and bacteriology to bear upon its manufacture, thus taking the making of butter out of the realm of empirical arts and putting it upon a scientific basis. As a consequence, butter is not only made more economically but it is of finer quality, and the annual consumption per capita is consequently increasing. Before the dairy industry had attracted the attention of scientific investigators it was believed that it was impracticable to make good butter west of the Mississippi River. But owing to the general adoption of improved methods in what was at one time considered the far West, there is a large product of fine butter in the trans-Mississippi States. In one of these States (Kansas) is the largest creamery in the world, while Iowa leads all other States in total production. It may be said that the butter belt is now west of Indiana, while it was formerly east of Ohio. This change has been brought about partly by the increased demand upon the Eastern dairymen for milk, partly by cheap cattle food and cheap transportation rates from the West to the great Eastern markets, and partly by the settlement of the West by people from the dairy districts of continental Europe with whom butter making was an inherited art.

While the production of butter in the United States is about 1,500,000,000 pounds annually, 94 per cent or more is consumed at home, leaving but 6 per cent or less for export. The exported butter consists chiefly of the inferior grades, very little of the high quality going abroad.

BUTTER AS A FOOD.

While the United States to-day perhaps leads all countries in the total production of butter, there are those which exceed it in the consumption per capita. This is due, probably, to the cheapness of meat in America compared with the prices in foreign countries. England consumes 30 pounds of butter per capita annually, while the people of this country eat but 20 pounds per capita. According to recently gathered statistics butter constitutes about 2 per cent of the total food and furnishes 19.7 per cent of the total fat in the average American diet. Butter is used by nearly all classes of society, and it has been found that in many cases working classes insist upon the best grades.

Besides being a food and furnishing a considerable source of energy, it may also be used as a special diet for some invalids. In cases of exhausting illness which has reduced the body or where quick growth needs extra nourishing, butter may be substituted for cod-liver oil. Since it is so easy to assimilate, large doses can be given with impunity. A quarter of a pound of good butter can be spread upon thin slices of bread and taken easily by nearly everyone needing this kind of concentrated nourishment.

HEALTHFULNESS OF BUTTER.

Butter is a food product concerning which there need be but little fear in regard to its carrying disease. As fat of any kind is a medium in which few bacteria can develop, butter is not considered a conveyer of disease to any such extent as milk. Furthermore, butter which is made in an uncleanly manner, or in insanitary surroundings, or from undesirable raw materials will usually make these facts manifest in one way or another by poor quality, usually accompanied by unpleasant odor and taste. Butter is such a sensitive product that its taste or smell quickly shows if it has been subjected to unwholesome surroundings.

PHYSICAL AND CHEMICAL QUALITIES OF BUTTER.

FLAVOR.

To the average consumer the flavor of butter is one of its most important attributes, and many highly esteemed judges pay little attention to anything but its flavor and aroma. As everyone knows, these differ greatly in the different butters. The principal factors in determining flavor and aroma, so far as known, are the development of various organisms of the lactic-acid forming group, the feed, and the period of lactation of the cow. In some cases, no doubt, the individuality of the cow also plays an important part. So widely have bacteria become recognized as of primary importance in develop-

ing butter flavor that many skillful makers depend upon this agency for producing flavor almost at will. In Denmark the practice is almost universal of pasteurizing the cream, and then using "starters," or cultures of organisms, favorable for the purpose. The cream is heated sufficiently to destroy most of its inherent bacteria, then cooled, and to it is added from 5 to 15 per cent of its weight of skim milk in which lactic-acid bacteria have been grown and allowed to develop until the cream contains about seven-tenths of 1 per cent of acid. The flavor developed by this process is mild and clean, and the butter keeps better than where no care is taken to destroy those ferments which are always inherently present in the cream and which tend to produce undesirable flavors.

The chief reason why butter made in the early summer is better flavored than that made at other seasons of the year is that the proportion of undesirable ferments to the acid-forming bacteria is smaller than during the cooler and winter months. As already stated, cream is not usually churned until the bacteria have developed from five-tenths to seven-tenths of 1 per cent of acid. If this amount of acid is not developed the butter will lack flavor and character, while if more than this amount of acid is developed the butter will be sour and have an undesirable flavor. It is an interesting fact that no other way of developing acid in cream will produce the desired result. Experiments have been made by the direct addition of the desired proportion of lactic acid, which is supposed to be the product of the bacteria which develops lactic acid, but with unsatisfactory results. It is evident that bacteria must do the work in a natural, progressive way, in order to produce the desired flavors. The importance of having the right kind of bacteria ripen the cream is so generally recognized that there are a number of bacteriologists in this and other countries who are devoting their entire time to making pure cultures of desirable species of the bacteria which form lactic acid and supplying these to butter makers, who use them to improve and maintain the flavor of their butter. While the industry is, as yet, a small one, it is increasing rapidly.

The flavor of butter made from clean and pure sweet cream is characteristic of butter fat. What flavor there is in such butter is dependent upon the character of the milk from which it is made, to a slight extent upon the period of lactation, and upon the feed of the cows. If these conditions are favorable, the flavor is mild and pleasant and is desired by many consumers. While sweet-cream butter is quite popular in some European markets, it is not much sought for in the markets of the United States and can usually be obtained only upon special orders.

There are many abnormal flavors that creep into butter in one way or another and which tend to lower its value for table use. The sources of some of these abnormal flavors are well known, while in other cases

they are still a subject of much speculation. It is, perhaps, not generally known how sensitive butter is to undesirable odors, not only after it is made, but even before the milk from which the butter is made is drawn from the cow. One prominent dairymen cites a case in which the abnormal flavor or taint was traced to some calf pens in front of the cows from whose milk this butter was made. The cows, breathing the tainted air, transmitted the undesirable odors to their milk and thence to the butter. Other taints come from the volatile oils of food eaten by cows. When these oils are pleasant, as in the case of clover and other foods, the flavor is desirable, but when they come from such vegetables as garlic, onions, cabbages, and turnips, from various weeds, stagnant water, etc., the imparted flavor is objectionable to most persons. In cases where the butter takes on a "fishy flavor" after a time, the cause is thought to be a fat-splitting enzyme, which is in the milk when drawn from the cow or is produced by organisms in the butter after it is made. Although bacteria can not live in any fat for more than a short time, the enzyme resulting from the bacteria does its work after the death of the latter. Salt which has absorbed disagreeable odors will impart them to butter in which it is used.

Whether or not the period of lactation of the cow exerts an appreciable influence upon the flavor of butter is still an open question. A number of carefully conducted experiments have apparently resulted in the negative. On the other hand, some butter makers whose product commands a fancy price hold that they prefer milk from fresh cows, even if it does not contain so much butter fat as that from a herd well advanced in the period of lactation. It is known that as the cow advances in her period of lactation the fat globules generally grow smaller in size and lighter in color and of a harder texture. The weight of evidence seems to make it probable that the stage of lactation has some influence upon the flavor of butter; yet it may be true that this influence can be entirely overcome by modern methods of butter making.

GRAIN, OR BODY.

The grain, texture, or body, of butter is perhaps less understood than any other of its attributes. It is unquestionably of greater importance than usually conceded, and probably exerts more influence upon the judgment of experts as well as of consumers than is generally recognized. The texture of butter should be firm and solid at temperatures ranging between 50° and 60° F. It should not be of the consistency of lard, on the one hand, nor of tallow, on the other, but somewhere between these two. Most makers aim to have it firm without being waxy, to the end that, when broken, the butter may have the fine granular appearance presented by broken steel. On the other hand, there are makers whose product commands the highest

price who aim to have their output as waxy as possible. This difference may be explained by the fact that the butter first described is made to be kept for some time before being consumed, while the latter sort is made for immediate consumption. It is thought that the butter in which the texture is so fine that the granular appearance is lost does not keep so well as that which has not been so much worked.

The body, or consistency, of butter should always be such that, when it is placed upon the table it can be easily spread upon bread or other articles of food with which it is usually eaten. This smeariness at a given temperature is affected by the period of lactation, by the breed of the cow (the animal playing a more important rôle in this single attribute of butter than in any other), and by the nature of her food. A class of foods, of which cotton-seed meal is typical, when fed in quantities ranging over 2 pounds per day to the cow, will produce butter that is hard and crumbly; but this tendency can be corrected by food of an opposite character, like linseed meal or wheat bran. The latter are representatives of a class of foods which tend to produce a comparatively soft, oily butter. It is interesting to note that the influence which food exerts is caused by a variation in the different fats composing butter fat. One class of foods increases the relative proportion of stearine, thus hardening the butter, and another class raises the proportion of olein, which softens the butter.

As cows advance in their period of lactation, the butter-fat globules become smaller and harder, thus affecting the texture of the butter correspondingly. It is commonly believed, although not conclusively demonstrated, that cows of the Jersey breed produce a specially firm butter and one that will resist the effects of a warm temperature.

The above-mentioned conditions will also have a bearing upon the churning temperature. Cream containing butter-fat granules that are small or hard will require a higher churning temperature than cream composed of fat globules that are large or soft. Butter which has not been subjected to temperature exceeding 58° or 60° F. in the process of manufacture will have a better texture than when allowed to become warmer during the making. This is an important consideration and one which all will do well to heed, as uncontrolled temperature is responsible for more bad butter than any other single factor in the making.

COLOR.

The natural color of butter varies from white to orange yellow, the shade depending upon the breed of the cow, and the character of her food. Next to nothing is known about the natural coloring matter in butter, hence it is impossible to control it to any appreciable extent. Nearly all of some breeds of cows, and some cows in nearly all breeds, will produce high-colored butter under good summer conditions and more or less color under almost all conditions. Other cows under

equally favorable conditions will produce butter extremely light in color at all times and practically colorless in winter. The want of uniformity in the natural color of butter has caused untold controversy in connection with oleomargarine as a substitute for butter.

THE EFFECTS OF SALT.

Nearly all the butter made in the United States is salted, although some is made without salt for special trade in large cities. The quantity of salt usually added is one-half to $1\frac{1}{2}$ ounces to a pound of butter. The finished article will then contain from 1 to 3 per cent of salt, depending largely, however, upon the moisture held by the butter. What is known as the highest class trade demands a much lighter salted butter than is demanded for the lower grades. Furthermore, there is an increasing tendency on the part of the best trade to ask for a butter containing less and less salt. Butter which has a clean, pure flavor needs little salt; that which is "off flavor" or tainted in any way is improved by being strongly salted.

Butter is affected in four separate and distinct ways by the addition of salt—

First. It deepens the color; hence it is important that the salt be equally distributed to maintain uniformity in color.

Second. It acts in a slight degree as a preservative by preventing the growth of decomposing bacteria, which are always present in fresh butter. The preservative effect of salt in butter is, however, far less than generally supposed.

Third. Salt has a tendency to make butter actually drier, but not apparently so. When added to butter in the usual quantities, each grain of salt attracts to itself enough moisture to dissolve it, thus forming a drop of brine. These drops unite to form larger ones, which are pressed out when the butter is worked. In this way more water is removed from salted butter in the process of making than from unsalted butter, other things being equal. In this connection it is interesting to note that the moisture in unsalted butter is usually in such a finely divided condition that it can not be seen, and consequently such butter appears much drier than salted butter, which may actually contain much less moisture. It is therefore very difficult to judge the moisture content of butter by its appearance—by sight or touch. It is safe to assume, however, that butter in which no moisture can be seen is lightly salted and carries, in innumerable microscopic drops, more water than the average creamery butter contains. On the other hand, butter in which the moisture appears in large drops or which is "lacking brine" has probably had a larger percentage of water worked out in the course of its manufacture, and is really, though not apparently, drier than unsalted butter.

Fourth. Salt brings out the flavor of butter in a way that is demanded

in most markets of this country, although in France and southern Europe no salt is used in so-called "table butter" that is to be consumed within a few days after its manufacture.

It is highly essential that the salt used in butter-making should not only be nearly pure—that is, 99 per cent sodium chloride—but that it should be kept in a clean, dry place. If exposed, salt will readily absorb unpleasant flavors from such articles as fish, smoked meats, oil, and tar.

While most butter makers in the United States practice dry salting, there are a few here and more in England and Europe who salt their butter with a strong brine. The advantages of this method are that there is no fear that the butter will be gritty from undissolved salt, and as the salt is sure to be equally distributed there is no danger of mottles from this cause. The method is practiced only when a lightly salted butter is desired; it would be impracticable to salt butter heavily in this way. The disadvantages of brine salting are that it requires more salt and more time than dry salting and is less convenient. While it may be used in small dairies, it would be almost impossible to practice this method in large creameries.

Butter will usually weigh less after the salt has been added and the butter worked than before. This is due to the fact, already mentioned, that salt unites, or collects, the small drops of moisture into drops so large that they can be separated from the butter, and, as the total weight of the water or brine thus separated exceeds the weight of salt added, the butter consequently loses weight by reason of salting.

When butter is kept in a dry room in the winter time grains of salt will be frequently observed on the surface of the package or on the surface of the butter itself. When the latter case is observed, it may be seen upon examination that the butter at the surface is several shades darker than that below the surface, caused by an inequality in the distribution of the salt. Dry air draws the moisture containing the salt in solution to the surface of the butter, where it is evaporated, leaving the salt in crystals. The difficulty, if it can be called such, may be obviated by keeping the butter in a cool, moist atmosphere.

BUTTER FAULTS.

The ordinary faults of butter can be traced, with very few exceptions, to the process of manufacture, and not to the animal secreting the milk or to her food. Hence, when the sensitiveness of butter to foreign odors, bacteria, molds, etc., during the various steps of its manufacture is better appreciated many of the faults now apparent in butter upon our markets will be overcome.

The faults of butter may be divided into two general classes—faults of appearance and faults of taste and aroma.

One of the serious defects often found in butter is lack of uniformity

of color, or what is commonly known as "mottles." This defect is seen in white streaks, spots, or blotches, which are most pronounced when a lump of butter is cut so as to show a broad, smooth surface. If this cut surface is held at a proper angle to the light, any lack of uniformity in color will be plainly noticed. So serious is this defect considered that butter otherwise perfect, but mottled, is graded as second class in the large markets. The causes to which this fault can be attributed are, first, particles of curd, differing in size, incorporated in the butter, and, second, an uneven distribution of the salt. Mottles in creamery butter are seldom caused by specks of curd, but in the poorer classes of dairy butter this kind of mottles is not infrequently seen. They are most likely to occur when the cream from which the butter is made is thin and allowed to ripen without being stirred, or when it is overripened without being strained. The cream being churned under these conditions, lumps of coagulated cream are incorporated in the butter, and as the casein does not take the butter color the result is a product full of white specks. When the trouble is caused in this way it can be obviated by washing the butter twice in a weak brine after the buttermilk is thoroughly drained off. After the last washing, instead of draining the brine from the butter, as is usually done, the butter should be dipped out of the brine with a hair or wire sieve; the specks of curd, being heavier than butter or water, will have sunk to the bottom of the churn.

Most of the mottles found in butter, however, are caused by an unequal distribution of the salt. When the wash water is considerably colder than the butter granules the exterior of the latter become harder than the interior; this prevents an equal absorption of the salt when the butter is salted and worked, and mottles result. Also, when thin cream is churned at a low temperature the butter usually comes in round, shot-like granules; on account of being round and quite firm it is with difficulty that the salt is equally distributed and, unless great care is exercised, the finished butter is mottled. Of course, if under the most favorable conditions the butter is not worked enough to distribute the salt equally, mottles will be noticed in the finished product.

Mottles may be prevented, then, by avoiding high temperatures in ripening cream, by frequent stirring during ripening, by straining the ripened cream into the churn, by avoiding exposure of the butter to temperatures too low while in granular form (which causes a difference between the interior and exterior of the butter granules), and by working the butter sufficiently to cause an equal distribution of the salt.

Another common fault is seen in the milky appearance of the brine showing the presence of more or less albuminous matter in the butter, which not only detracts from its appearance, but also from its keeping quality. This fault may usually be overcome by a lower churning temperature, stopping the churn when the granules are about like

grains of wheat, and thoroughly washing with a weak brine having a temperature of about 5° lower than the butter at that time.

A salvy, smeary appearance of butter is a common fault. This is caused by overworking or by working at a high temperature, and is easily overcome unless, as is sometimes the case in home dairies, it is impossible to keep the temperature well down in the fifties during the process of churning and working. On the other hand, butter that is what is technically known as "short bodied"—that is, brittle, like tallow—has also a serious fault. This may be caused by feeding certain foods, like cotton-seed meal, in excess. Butter which has been churned at a low temperature, thus delaying the coming of the butter for a long time, or butter that has been very much overchurned, will be likely to have a greasy, lusterless appearance, a fault that is to be carefully avoided.

Much has been heard at times about moldy butter. This trouble is caused by distinct kinds of molds of various colors, the spores or germs of which are present in tubs and boxes made from improperly seasoned wood or those which have been held in damp storerooms. The fault is a serious one, but may be easily avoided by exercising proper oversight in the purchase and care of the packages or, in cases where the trouble is suspected as likely to occur, by treating the package and its parchment paper lining with a weak solution of formalin. Care should also be exercised to keep the butter, if stored, in a clean place.

The faults of taste and smell are not more serious, perhaps, than the faults of appearance, but are much more numerous and vary in degree from insignificance to the complete ruining of the butter. A most common one of these faults is the taste caused by the cows eating wild garlic or any similar taint-producing vegetable matter, but this may be remedied by specific treatment of the animal and its feeding which is now well understood. Tallowy butter is caused by the cows eating tallowy tasting meal or an excess of young green clover; this taste will also appear in butter that has been exposed to the light for some time, and also in butter that has been frozen and thawed several times. Other similar faults, such as sourness or "frowy," oily, fishy, cheesy, soapy, and smoky tastes and smells, are not uncommon. It is impracticable to describe specific causes and remedies for each of these faults. All are due either to lack of care or cleanliness, and indicate the want of skill or oversight somewhere in the process of manufacture. Patient investigation will develop the cause in any particular case, and the remedy is then likely to suggest itself.

PASTEURIZED-CREAM BUTTER.

The practice of making butter from milk or cream which has been heated to a temperature sufficient to kill practically all of the bacteria present has been carried on in Denmark for a number of years. This method, however, has made but slow progress in America, due par-

tially to the fact that consumers of butter demand a higher, stronger flavor than that produced by the Danish process, and partially to a lack of skill on the part of the operators who first put it in practice here. It may have been, too, because pasteurization was often made a cloak to cover up filthy and slovenly methods of producing and caring for milk. Pasteurization can not be considered a panacea for dirt or carelessness, and butter makers who can not make good butter without pasteurizing can not expect to produce a superior product in that way if other conditions remain the same. As the principles of the method and the benefits to be derived from it become better understood, the practice of pasteurizing the milk or cream to be used for butter making is increasing in the United States.

The advantages to be derived from pasteurizing are that, when properly done, the butter is more uniform in texture and flavor, although the latter is comparatively mild. The importance of having butter uniform in these two particulars can not be overestimated. Again, butter made from cream which has been subjected to a heat of from 180° to 185° F. keeps much better than that made from cream not so treated, and hence is better for storage and for export. Another advantage of pasteurizing is that milk or cream heated to the above-mentioned temperature is freed from undesirable bacteria of all kinds, and as this includes all disease germs it is a source of comfort and security to the butter consumer. Disease germs are of rare occurrence in butter, however, in this country. An indirect advantage accruing from pasteurizing lies in the fact that, when all milk brought to a creamery or skimming station by patrons is pasteurized, it is a guaranty that the skim milk will not carry any pathogenic organisms back to the farm to infect the calves or pigs to which it is fed.

If, however, the cream that has been pasteurized is not properly cared for and ripened with a desirable ferment, or if the cream or milk is heated too high, the result will be disappointing and not so good as it might have been had pasteurizing not been attempted. Pasteurization does not change the composition of the butter to any appreciable extent. The only influence exerted in this respect is in the moisture content. It is believed that when milk or cream is heated to the extent necessary for pasteurization the butter usually contains rather less moisture than it otherwise would carry.

COMPOSITION OF BUTTER.

The average composition of butter is about as follows:

	Per cent.
Water	12
Fat	84
Casein, albumin, and sugar	1
Salt or mineral matter	3

Of course, unsalted butter contains but a trace of ash or mineral matter, and it usually contains about 1 per cent more of moisture than salted butter. The percentage of water is the most variable constituent, but when butter is well made under favorable conditions this seldom exceeds 15 per cent. If butter contains an excessive amount of moisture, it not only deceives the consumer, but will not hold its quality under ordinary conditions. On the other hand, butter which contains a low percentage of moisture (that is, from 6 to 9 per cent) will not, as a rule, have a well-developed flavor, and soon becomes tallowy. The highest quality in body and flavor is usually found to carry from 10 to 14 per cent of water.

Physically, butter is made up of a great number of minute fat globules, which have moisture adhering to their surface and held between them, and this water holds in solution casein and sugar and salt. It is estimated that a pound of butter contains from 720,000,000 to 180,000,000,000 of fat globules. Because the fat is in such a finely divided condition it is almost completely digestible and especially adapted for human food. Butter fat is made up of ten components, and this complexity distinguishes it from other fats—animal and vegetable. Its composing fats are of two classes—the volatile, which form but about 9 per cent of the total, and the nonvolatile fats. The relative proportion of the various fats is dependent, to a greater or less extent, upon the period of lactation, character of food and feeding, and exposure to inclement weather and other discomfort and excitement. The breed of the cow also seems to have some relation to the component fats.

Because butter is composed of so many different kinds of fats, it is easily decomposed, and, unlike other fats, this decomposition takes place sooner or later in spite of all known methods of preservation. The composition of butter, as well as its physical characteristics, is subject to considerable variation. These variations are brought about by the causes mentioned as affecting the changes in butter fat.

THE YIELD OF BUTTER.

Much has been said and written about the yield of butter from a given quantity of milk or cream. The yield of butter that can be produced will depend, within reasonable limits, upon the water that is incorporated during the process of churning, or the water expressed during the manipulation or working of the butter. It is not to be doubted that certain definite, fixed physical laws control both of these operations, but so far as generally known these have not yet been determined. It is known that water can be worked into butter by various means which have been employed by unscrupulous persons, but it is not generally known why the butter from a churning one day will contain 10 per cent of water and the next day a higher percentage

when the conditions governing both churnings are apparently the same. Therefore, if all butter contained the same proportion of moisture, and the work of manufacture was well done, all lots of milk or cream of the same composition would produce approximately equal quantities of butter. As a matter of fact, however, this is seldom the case, and, in instances where milks or creams differ in their composition, other conditions being equal, the richer milk or cream will yield proportionately more butter. The explanation of this fact is that there will be fewer pounds of by-products in the case of the richer milk or cream, and these by-products will be poorer in fat than in the case of the poorer milk or cream.

With the modern methods of manufacture, average milk should produce butter containing between 83 and 84 per cent of fat, and, in consequence, 100 pounds of fat in the milk should yield about 113 pounds of butter. This relates to average practice. The agricultural experiment stations have agreed that when all conditions are perfect, or nearly so, butter should exceed the fat churned by 16 per cent.

Fleischmann says that in churning sour cream with a fat content of 15 to 25 per cent, 97 or 98 per cent of the total fat in the cream should be recovered in the butter, but that when sour milk is churned but from 88 to 89 per cent of the total fat will be recovered in the butter. For estimating the yield of butter from both sour milk and cream where fat content is known, the same authority gives the following formulas: In the case of milk the yield of butter $X = 1.05 \times f$, where f represents the amount of fat in the milk. Where cream is used $X = 1.155 \times f$. It is needless to explain why the yield is so much larger in the latter case. Any perceptibly greater yield than this is manifestly at the expense of the fat content of the butter, and a much less yield indicates a needless waste in some part of the process of manufacture.

JUDGING BUTTER.

Unfortunately, there is no exact method for judging butter; that is, there is no method which will give to the same butter exactly the same valuation if tested by a number of different judges. Butter is now judged, by more or less experienced men, by the senses of smell, taste, touch, and sight. None of these are exactly alike in any two persons, nor are they at all times the same in the same person, and according to these differences will the record of judging vary. Again, prejudices, likes and dislikes, enter in to bias judgment to a greater or less degree, although their influence is not recognized. Furthermore, so-called good judges will differ considerably in their standards of perfection. Consequently, while no better method is suggested, the result of judging butter, as it is done at present, is very unsatisfactory. It has been thought by some and hoped by others that there might be a definite relation established between the volatile fatty acids

of butter and its flavor and commercial quality, but recent European data seem to prove conclusively that no such relation exists. The most that can be said of the practical importance of the volatile fatty acids is that they are generally held to indicate the purity of butter and aid in detecting adulterations with other animal or vegetable fats; but even this matter is in dispute.

GRADES OF BUTTER.

The following classification and descriptions of the various grades of butter, extracted from "the butter rules" of the New York Mercantile Exchange, apply especially to that market; but they differ only slightly, if at all, from the rules and regulations governing other large distributing centers:

1. Butter shall be classified as Creamery, Imitation Creamery, Dairy, Factory, Renovated, Grease, and Known Marks, and shall be graded as Extras, Firsts, Seconds, Thirds, and Fourths.

2. The standard official score shall be as follows:

	Points.
Flavor.....	45
Body	25
Color	15
Salt	10
Style	5
Perfection	100

3. *Creamery butter*.—Butter offered under this classification shall have been made in a creamery from cream obtained by the separator system or gathered cream.

4. *Imitation Creamery butter*.—Butter offered under this classification shall have been churned by the dairyman, collected in the unsalted, unworked condition, and worked, salted, and packed by the dealer or shipper.

5. *Dairy butter*.—Butter offered under this classification shall be such as is made, salted, and packed by the dairyman and offered in its original package.

6. *Factory butter*.—Butter offered under this classification shall have been collected in rolls, lumps, or in whole packages and reworked by the dealer or shipper.

7. *Renovated butter*.—Butter offered under this classification shall be made by taking pure butter, melting the same, and rechurning with fresh milk, cream, or skim milk, or by other equivalent process.

8. *Grease*.—Shall consist of all grades of butter below Fourths, free from adulteration.

9. *Known Marks*.—Shall comprise such butter as is known to the trade under some particular mark or designation, and must grade as Extras if Creamery, and Firsts if Renovated butter, in the season in which it is offered, unless otherwise specified.

10. Packages must be sound, with full number of hoops, covers tight and properly fastened, or made so at the seller's expense, unless otherwise stipulated at the time of sale.

11. *Grades*.—Grades of butter must conform to all of the following requirements and shall not be determined by the score alone.

12. *Extras*.—Shall be composed of the highest grades of butter made in the season when offered under the different classifications; 90 per cent shall be up to the following standard; the balance shall not grade below Firsts:

Flavor must be fine, sweet, clean, and fresh, if of current make, and fine, sweet, and clean if held.

Body must be firm, smooth, and uniform.

Color, a light-straw shade, even and uniform.

Salt, medium salted.

Package, good, uniform, and clean.

Score shall average 93 points or higher during the months of May, June, July, August, September, and October, and 91 points or higher during the balance of the year.

13. *Firsts*.—Shall be a grade just below Extras and must be fine butter for the season when made and offered, under the different classifications, and up to the following standard:

Flavor must be good, sweet, clean, and fresh if of current make, and good, sweet, and clean if held.

Body, good and uniform.

Color, reasonably uniform, neither too high nor too light.

Salt, medium salted.

Package, good and uniform.

Score shall average 85 points or higher.

14. *Seconds*.—Shall be a grade just below Firsts, and must be good for the season when offered under the different classifications, and up to the following standard:

Flavor must be reasonably good and sweet.

Body, if Creamery or Dairy, must be solid boring; if Factory or Renovated, must be 90 per cent solid boring.

Color, fairly uniform.

Salt, may be high, medium, or light salted.

Package shall average 80 points or higher.

15. *Thirds*.—Shall be a grade just below Seconds.

Flavor must be reasonably good; may be strong on tops and sides (of packages). Body, fair boring, if Creamery or Dairy, and at least 50 per cent boring a full trier, if Factory or Renovated.

Color may be irregular.

Salt, high, light, or irregular.

Package, fairly uniform.

Score shall average 75 points or higher.

16. *Fourths*.—Shall be just below Thirds and may consist of promiscuous lots.

Flavor may be off-flavored, and strong on tops and sides (of packages).

Body not required to draw a full trier.

Color may be irregular.

Salt, high, light, or irregular.

Package, any kind of package mentioned at time of sale.

17. *Grease*.—Shall consist of all grades of butter below Fourths, free from adulteration.

While the amount of butter sold on commission in the largest markets is decreasing year by year, all that is sold in this way is graded in a manner similar to the above. If the buyer and seller can not agree as to the grade of any lot, the question is settled by an official inspector appointed by the board of trade or the produce exchange of the local market. The question of weights is settled in the same manner.

As before stated, less butter is now sold on a strict commission than was formerly the case. Butter merchants at present, instead of depending upon consignments of butter to be sent to them to be sold

for a percentage of sales, go into the butter-producing districts and contract for the total output, or "make," of a creamery for the entire year or producing season at a fixed price, or at the highest current quotations of the market for which the goods are bought, or for so much above or below these quotations. The advantage of this practice is that it gives the merchant a reasonably uniform supply for his trade, and to the producer it gives the advantage of knowing what he is to expect for his product when it reaches the market, or even before.

BUTTER SUBSTITUTES.

At the present time there are three commercial substitutes for butter as it comes from the creamery or dairy churn. These are oleomargarine, butterine, and renovated butter. These substitutes are manufactured and sold under the surveillance of the United States Government, and are subject to special taxes. As is well known, oleomargarine is a mixture of various animal and vegetable fats, which is churned with milk to impart a butter flavor. The principal fats used are as follows: Oleo oil, a selected fat from beef that is obtained from the caul fat; this is thoroughly washed, well chilled in ice water, then cooked, cooled, and put into hydraulic presses by which the oil is extracted. "Neutral," or neutral lard, "is the leaf lard of the pig; the leaf fat, when taken out of the animal, is thoroughly washed and put into a refrigerator where it remains twenty-four hours; it is then well cooked, and becomes absolutely colorless and has neither taste nor odor." The vegetable fat commonly used is cotton-seed oil; "the oil is extracted from selected cotton seed and then highly refined."

Butterine is oleomargarine with which is mixed more or less butter. This is a purely commercial term, however, and not recognized by law. All "butterine" is legally oleomargarine.

Renovated butter is made "from one or more lots of butter which have been subjected to any process by which it is melted, clarified, or refined," for the purpose of removing rancidity, or any deleterious flavors, or of otherwise improving and rendering uniform miscellaneous lots of butter which could not find a profitable market without being subjected to some such process of renovation. It is understood that renovated butter is pure butter, but is made from stock that in itself is not fit for table use. The purpose of Government surveillance is to see that regulations are observed whereby no unwholesome material or process is used and so that the purchaser and consumer are advised as to the true character of this kind or grade of butter.

ADULTERATIONS OF BUTTER.

The adulterations that are usually found in butter are water, foreign fats, glucose, starch, and preservatives of one kind or another, such as

boric acid. A butter is deemed adulterated, under constructions placed upon laws of the United States by the administrative officers of the Government, when it contains more than 16 per cent of moisture, any foreign fat, or any chemical or other substance used for the purpose of removing rancidity or of cheapening the product.

The national laws concerning butter adulteration are so rigid and so well enforced that very little butter is now found upon the market, even of the poorer grades, which can be condemned as adulterated. The most common cases of adulterated butter are those where water in excess of the legal allowance is incorporated, either intentionally or unintentionally, during the process of manufacture or afterwards, for the purpose of adding to its weight. Martiny, an eminent German dairy authority, compiled the percentage of moisture in 17,332 samples of butter from analyses in various countries and found the average to be 13.55 per cent. From this it may be judged that it is exceptional to find butter naturally containing more than 16 per cent of moisture. The other adulterants are so rarely found that they need scarcely be considered in this connection.

HOME TESTS FOR BUTTER.

Housekeepers find it satisfactory to determine at home whether "butter" which has been purchased is genuine or counterfeit. Although there is more than one method of determination, the boiling test, as given in Farmers' Bulletin No. 131 of this Department, is the best one to repeat here. The experiment may be conducted in the kitchen as follows: Using an ordinary coal-oil lamp as a source of heat, melt a piece the size of a small chestnut taken from the suspected sample in an ordinary tablespoon, hastening the process by stirring with a splinter of wood (a match will do). Then increasing the heat, bring to as brisk a boil as possible, and, after the boiling has begun, stir the contents of the spoon thoroughly, not neglecting the outer edges, two or three times at intervals during the boiling, always shortly before the boiling ceases. Oleomargarine and renovated butter boil noisily, sputtering more or less, as a mixture of grease and water would naturally behave when boiled, and produce no foam or but very little. Renovated butter produces usually a very small amount of foam. Genuine butter ordinarily boils with less noise and produces an abundance of foam. The difference in regard to foam is, as a rule, very marked. A butter is rarely found which yields an uncertain result, but if uncertain it should be considered genuine butter or a case of suspicion not confirmed.

THE COST OF BUTTER.

The cost of producing a pound of butter varies widely under different conditions. So wide are these variations that it is almost impos-

sible to state, with any degree of definiteness, what is the average cost. Few producers can themselves tell, in anything more than a general way, how much net profit there is in butter dairying. This is mainly because so few take into account all the factors that have a bearing upon the cost, such as the interest on the value of the herd, deterioration in buildings and cattle, and labor of all kinds, including the time of owner or other members of the family. It will be readily seen that it requires considerable bookkeeping and careful judgment to form anything like an accurate estimate on all the items of cost involved in producing a pound of butter. Among the most reliable records are those published by the New Jersey Experiment Station, and even these do not strictly apply to butter making, as the figures are given for the production of hygienic milk and will have to be adapted to butter making as nearly as may be possible. This station gives \$1 as the cost of 100 pounds of milk containing, according to test, 4.25 pounds of butter fat. If skim milk and buttermilk are reckoned at 20 cents per 100 pounds and their value deducted from the cost of the milk, the net cost of 4.25 pounds of butter fat will be 81 cents. This quantity of butter fat should produce 5 pounds of merchantable butter; hence the cost of producing the butter will be 16 cents per pound, plus the expense of labor. Three cents per pound is a fair estimate of the cost of making and marketing the butter. It is safe to assume that when butter is made under good conditions its cost in the Middle and Eastern States should be reckoned somewhere from 18 to 20 cents. Farther West, where feed is cheap, the cost will be less, and, although much farther from the markets, it actually costs less to put Kansas or Nebraska butter into the New York market by freight in refrigerator cars than it does to ship butter by express from near-by points to the same market.

It will be seen from the compilation of average New York prices for thirty-seven years that with good cows there has nearly always been a little money for the butter dairy. It should be borne in mind, too, that a great many dairymen in the East, where the cost of production is the greatest, have special customers for their product, at prices considerably above the average market price. On the other hand, the fact should be noted that a large part of the "dairy butter" (made on farms) is sold below the highest quotations, and much of it is probably the cause of actual loss to the producers.

PRICES FOR BUTTER.

During the past thirty-five years the total production of butter in the United States appears by the best statistics available to have increased approximately threefold. With this enormous increase in quantity there has been a corresponding increased demand. From various causes there has been great fluctuation in price. The follow-

ing table shows the variation in the highest price quoted for butter on the New York market for the past thirty-seven years:

Year.	Price.	Year.	Price.	Year.	Price.
	<i>Cents.</i>		<i>Cents.</i>		<i>Cents.</i>
1866.....	51.1	1879.....	25.5	1892.....	26.4
1867.....	41.6	1880.....	30.5	1893.....	27.2
1868.....	49.9	1881.....	32	1894.....	22.8
1869.....	47.3	1882.....	35.5	1895.....	21.8
1870.....	40.3	1883.....	31	1896.....	18.5
1871.....	35.5	1884.....	30.1	1897.....	19.0
1872.....	34.7	1885.....	26.8	1898.....	19.6
1873.....	39.4	1886.....	27.4	1899.....	21.4
1874.....	41.8	1887.....	26.9	1900.....	22.4
1875.....	34.8	1888.....	27.3	1901.....	23.8
1876.....	34.5	1889.....	24.2	1902.....	24.7
1877.....	30.6	1890.....	23.6		
1878.....	28.3	1891.....	26.2		

While there is no effect without a cause, the cause is in this case so complex that it is impossible to name any one of the many possible factors as having more influence than any other. There seems to be but little if any relation between the price of butter and meat, nor is there any apparent relation between the total population and the production of butter and its price. Two factors may be mentioned as probably influential in the fluctuations shown: First, irregularity of production, from various causes, giving markets a surplus at one time and at another causing some scarcity of supply; second, "the times," or the greater ability or willingness of the wage-earners to buy at one time over another, which results in a variation of the demand.

DISTRIBUTION OF BUTTER.

Only a small part of the butter produced is consumed at the place where made. This necessitates the shipment of much the greater part to populous centers and distribution to the consumer through various channels. The great butter-distributing markets are Chicago, New York, Philadelphia, Boston, and St. Louis; San Francisco will soon be added. Butter is sent to these markets either by freight or express, by rail or boat. From the large producing areas it is transported in through refrigerator cars, and reaches the cellars of commission merchants and distributors in prime condition. From these cellars it is sold to jobbers and retail merchants, who, in turn, sell to consumers.

A large part of the total butter produced is made during the summer months. To keep the surplus until winter, when there is a shortage in the production, it is put in large storehouses in the great cities and held at a temperature varying from 20° F. to well below zero. When held at a constant low temperature, the quality of the butter deteriorates but slowly. In consequence, butter made in May, June, and July,

when all the conditions are favorable, and put in cold storage or "freezers" for seven or eight months is better than the greater part of that freshly made during the winter months, when the conditions are often unfavorable. This system of storing or holding butter makes it possible to distribute advantageously through the period of comparative scarcity the enormous surplus of a few months' production.

DETERIORATION OF BUTTER.

Butter fat, and hence butter, is very unstable, and consequently begins to deteriorate soon after it is made. This deterioration continues until the butter is no longer fit for human food. Not all the conditions which combine to cause butter to spoil are thoroughly understood, and it is probable that the changes which occur in a spoiling butter are based upon causes partly chemical and partly bacteriological. It is believed that one or possibly both of these agencies may be hastened in their work by the presence of sunlight. Butter exposed to the light will take on a lighter color at the surface, which gradually spreads downward until finally the entire mass becomes somewhat bleached. As the butter loses color it develops a tallowy taste and odor. As the deterioration progresses the texture changes from a firm or solid condition to a semipasty mass. When this stage is reached the butter is, of course, fit only for soap grease. The acquirement of the peculiar flavor which is generally recognized as rancidity is usually included in the changes wrought by time, but this is by no means always so.

There are many ways by which these deteriorating changes can be retarded, but so far as yet known there is no process or method by which they can be entirely prevented. The most common and most successful way of preserving the quality of butter is by the method, already described, of storing it at low temperature and in a darkened place. Where successfully practiced this system will keep butter with comparatively little deterioration from six to ten months. On account of the expense involved this method is practicable in commercial and distributing centers only, where large quantities of butter and other perishable products can be cared for in one building.

To preserve butter that is to be shipped to tropical countries it is often made from pasteurized cream and packed in hermetically sealed cans. Butter made in this way will usually keep for a considerable length of time, although changes are quite certain to occur soon which will make the butter unpalatable to consumers accustomed to fresh butter. More or less butter prepared in this manner is also treated with a small quantity of some chemical preservative, such as borax or boric acid.

As has been stated, while butter can not be prevented from deteriorating, much can be done to retard this action by handling it in all

stages of its production under the utmost cleanly conditions, by pasteurizing the cream from which it is made, guarding it against infection by troublesome germs, packing in air-tight packages, and holding it at low temperature and in darkness.

CARE OF BUTTER.

The care of butter is a consideration worthy the attention of all who handle this important food product. A small quantity of butter cut from a large package and left exposed will soon lose its freshness and aroma. Butter packed in the form of bricks and wrapped in parchment paper will not retain its original aroma and flavor so long as butter that is put up in tight packages of greater size. Prints and pats are pleasing to the eye, but they are not sensible, unless the wrapping is uncommonly well done, so as to make an almost air-tight package. It should still be remembered that, as a rule, the larger the package or bulk of butter, the better it will keep. Small vessels of glass or glazed earthenware, with the least possible surface exposure of butter, are suitable for family use.

For household storage butter should be kept in a cold, dark place and separate from other foods which have any appreciable odor. If a refrigerator is not available, a vessel of pottery upon a cool cellar bottom is perhaps the best place. Special care should be taken to keep it away from places and things infested with mold of any kind.

BUTTER LAWS.

Twenty-two States and the District of Columbia have laws that apply directly to butter. Of these, seven merely define butter to mean "the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter." (This is the wording of the United States law of 1886.) One State specifies that the coloring matter shall be harmless. Two States have legislated against the addition of "poisonous or deleterious substances," and one specifies that no boracic or salicylic acid or injurious antiseptics shall be allowed in the manufacture of butter. California, a State in which a great deal of butter is sold in two-pound rolls, requires that roll butter must be full weight. Connecticut's butter law states that "tub butter"—that is, originally packed in bulk—must be labeled "tub butter" when reworked and sold in the form of prints, pats, or rolls. The District of Columbia, besides defining butter as above, has a standard of 83 per cent fat and not more than 12 per cent of water or 5 per cent salt. Minnesota and New York butter laws specify that butter shall not be falsely branded. North Dakota requires creameries to brand each package of butter, giving quality of product; no false brands are allowed and all brands must be registered with the dairy commissioner.

Ohio and Oregon each have a butter standard, the former requiring 80 per cent of fat and the latter not allowing more than 14 per cent of moisture; Minnesota fixes 16 per cent as the maximum water content. Rhode Island's law states that all butter tubs shall be marked with their weights and makers' initials. Vermont does not allow butter to be branded "creamery" unless it is the product of a factory or creamery, although packages may be branded "private creamery" if the name of maker is also given. Virginia requires that butter inspectors shall brand lots of butter offered for inspection according to quality.

SUMMARY OF CONCLUSIONS.

Butter has been, is, and will long continue to be the principal feature of American dairying. Consequently any improvement made in this product will be a direct benefit to more dairymen than would profit from advance in other lines of dairying. The creamery, or associated system of manufacture, has done much to improve the quality of American butter, and if all butter came directly from creameries there would be no such quantities sold by producers at prices which are often actually below the cost of production, as is the case at the present time. Statistics for 1900 show that one-half of all butter reaching market in the United States was produced in private dairies, graded in the markets as dairy butter, and sold at least 3 to 5 cents per pound less than creamery butter. It is undoubtedly possible for butter made in home dairies to be as fine in quality as any creamery butter, and in many cases it is so, and commands prices accordingly. But a very small percentage of all dairy butter made is of really high grade. The essentials for successful home-butter making may be briefly stated as follows:

- (1) Cleanliness, by which is meant not only clean utensils, but clean and well-ventilated dairy rooms, pure air, and freedom from all foreign odors that may taint milk, cream, or butter.

- (2) Regularity in attention to the details of dairy work. Conditions should be under such control and the work be so regulated that every part of it is attended to at a fixed time. Further, the conditions regulating the ripening of the cream and churning should be such that when the fixed time arrives for doing certain parts of the work everything will be just ready to move along. "Order is heaven's first law," and in no place is conformity to this maxim more important than in the farm dairy.

- (3) Low temperatures. The process of butter making, from beginning to end, affords favorable conditions for the development of various ferments. It is therefore essential to keep the temperature under complete control and within limits that will, on the one hand, favor the development of desirable bacteria, and will, on the other, check

and prevent the growth of the undesirable ferments. In this day of hand separators, where the cream that needs to be kept under control is but a small fraction of the milk from which it was taken, the desired conditions of temperature are easily obtained. If the temperature during the entire process of manufacture, from the time the cream is cooled after separation to the time the butter is packed ready for market, is not allowed to exceed 60° F., one important condition will have been met, tending to improvement of dairy butter.

(4) Ripening the cream. The quality of butter depends upon the proper ripening of the cream more than upon any other single step in the process of making. It is safe to say, too, that a person who is particular and successful in ripening cream will not be likely to lack in other requirements of a prime butter maker. All successful makers are now depending almost entirely upon a "starter" of some kind to ripen their cream. The present status of butter making would seem to indicate that the "starter" is almost necessary to make uniformly good butter. There are two classes of starters—the commercial and homemade—and either will give excellent results if properly handled. One or the other should be used by every butter maker who aims to produce a high-grade article. In connection with the "starter" in ripening cream may be mentioned the use of the acid measure to determine the amount of acid that has been developed. Experience has demonstrated that an insufficient amount of acid in the cream will fall short of giving satisfactory results, while too much will be detrimental. In order to know when the desired point in acidity is reached (and this is generally agreed upon as 0.55 to 0.65 of 1 per cent of acid), it is necessary to have some kind of an acid measure. The most convenient form of measure for home use is no doubt the Farrington alkali tablets, which may be obtained from almost any dairy supply house, with full directions for use.